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A SCHEME FOR A HIGH-VOLTAGE ELECTROSTATIC GENERATOR WITH A GROUNDED METAL SHAFT

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Summary: This article describes a scheme for a high-voltage multi-disk generator with a grounded metal shaft. This new scheme offers considerable advantages in design and construction, makes the generator self-exciting, and facilitates the output of high voltages since it replaces one outlet at full voltage by two outlets at half voltage. Instead of high-ohmic distributors, it is proposed that thin poorly-conducting layers be used both in the generator's disks and in the surface of the high-voltage outlet leads.

The types of high-voltage electrostatic generators described [1 - 4] by us earlier required that the potential in the region where the shaft of the rotor passes through be equal to half of the maximum voltage. Under these conditions one could design the shaft by two methods: 1) by making the shaft out of insulating material or 2) by insulating a metal shaft to half of the generator's voltage. A shaft made of insulating material possesses insufficient physical and mechanical properties; on the other hand, insulating a metal shaft to such high voltages creates problems of design and construction and moreover introduces strong distortions in the electrical field.

In this article we propose a scheme for a multi-disk generator with a grounded metal shaft.

The generator possesses two high-voltage outlets at voltages $\frac{1}{2}V_2$ and $-\frac{1}{2}V_2$.

The shaft placed midway between them is at zero potential. Figure 1 illustrates the stator disk; the rotor disks do not differ from those described in a previous work [4]. The brushes 1 and 2 feeding the primary voltages $+V_1$ and $-V_1$ are located in the regions of zero potential; sectors I and II of the stator are grounded.

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The rotor's sectors, proceeding around brush 1 (with a potential of $+V_1$) receives the charge and transmits it to the high-voltage sector A at a potential of $+\frac{1}{2}V_2$. The charging device, up to the outlet from region A, imparts to the rotor a negative charge $-q$ at a potential equal to $\frac{1}{2}V_2 - V_1$. A similar process occurs also in the second brush (with potential $-V_1$) and supplies its charge to the high-voltage sector B at potential $-\frac{1}{2}V_2$. A charging device is placed in sector B.

Such a generator can operate in self-excitation, and the supply of primary voltage in sectors I and II, accelerating the original process of charging the sectors A and B, fixes a definite polarity. Actually if sector A is already charged to a potential $+\frac{1}{2}V_2$ and if there is present a charging device in sector A, then the rotor's sectors will obtain in this case a negative charge, which is transferred afterwards to sector B; and a positive charge, which has been transmitted by the charging device to sector B, passes over to sector A. The charging devices must be so regulated that the charge transmitted to them creates, between the rotor and the stator, a potential difference equal to V_1. The voltage drawn off, on the other hand, equals $+(\frac{1}{2}V_2 - V_1)$ and $-(\frac{1}{2}V_2 - V_1)$; however if the transformation coefficient is considerable we then have $\frac{1}{2}V_2 >> V_1$ and hence the voltage drawn off differs only slightly, for all practical purposes, from the values $+\frac{1}{2}V_2$ and $-\frac{1}{2}V_2$.

If one supplies to both brushes 1 and 2 of the generator a voltage of single sign, then the potentials of both sectors A and B will also have the same sign and will equal $\frac{1}{2}V_2$. If we have such a parallel connection of both generator halves than we shall obtain double current at half the secondary voltage.

The scheme in Figure 1 with a grounded shaft considerably facilitates leading out the secondary voltage, since in the place of a single outlet at voltage V_2 we need two outlets each at voltage $\frac{1}{2}V_2$. It simplifies considerably the problem of distributing the potential difference within the generator to the individual sections. The plane passing through sectors I and II and the axis possesses zero potential and divides the generator into two indipendent halves, in which the potential varies from 0 to $\pm\frac{1}{2}V_2$, respectively. In the zero-potential plane one can place the massive metal frame, which is the base necessary for securing fast all the various parts of the generator. Figure 2 shows how the outlets and conducting screens, which assure a forced distribution of potential by sections, are disposed. In the types described by us [4-5] the forced distribution of potential was effected with the aid of high-ohmic resistances. Their junction points and even the resistances themselves are undesirable focal points of corona discharge which are difficult to eliminate. At present we are conducting research on poorly-conducting thin layers with a sharp dependence of electrical conductivity upon the electric field strength, with the aim of creating a forced uniform distribution of potential.

Preliminary experiments indicate that, due to the sharp drop in resistance with increasing field intensity, the poorly-conducting layer smooths over the local excess voltages and approximates a uniform voltage distribution.

We hope, with the aid of such layers applied to the generator's disks (dash-shaded part in Figure 1), to simplify the problem of potential distribution, and also to lower somewhat the dimensions of the outlet leads.

Literature

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[*Note: ZhTF is Zhurnal Tekhnicheskoy Fiziki (Journal of Technical Physics).]

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Figures appended

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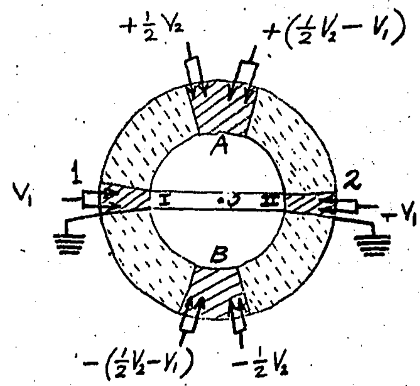

Figure 1.

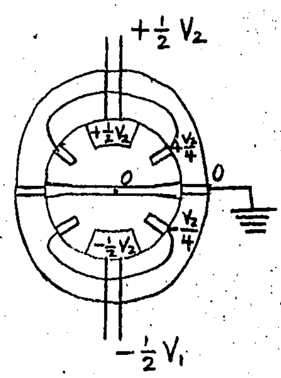

Figure 2.

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